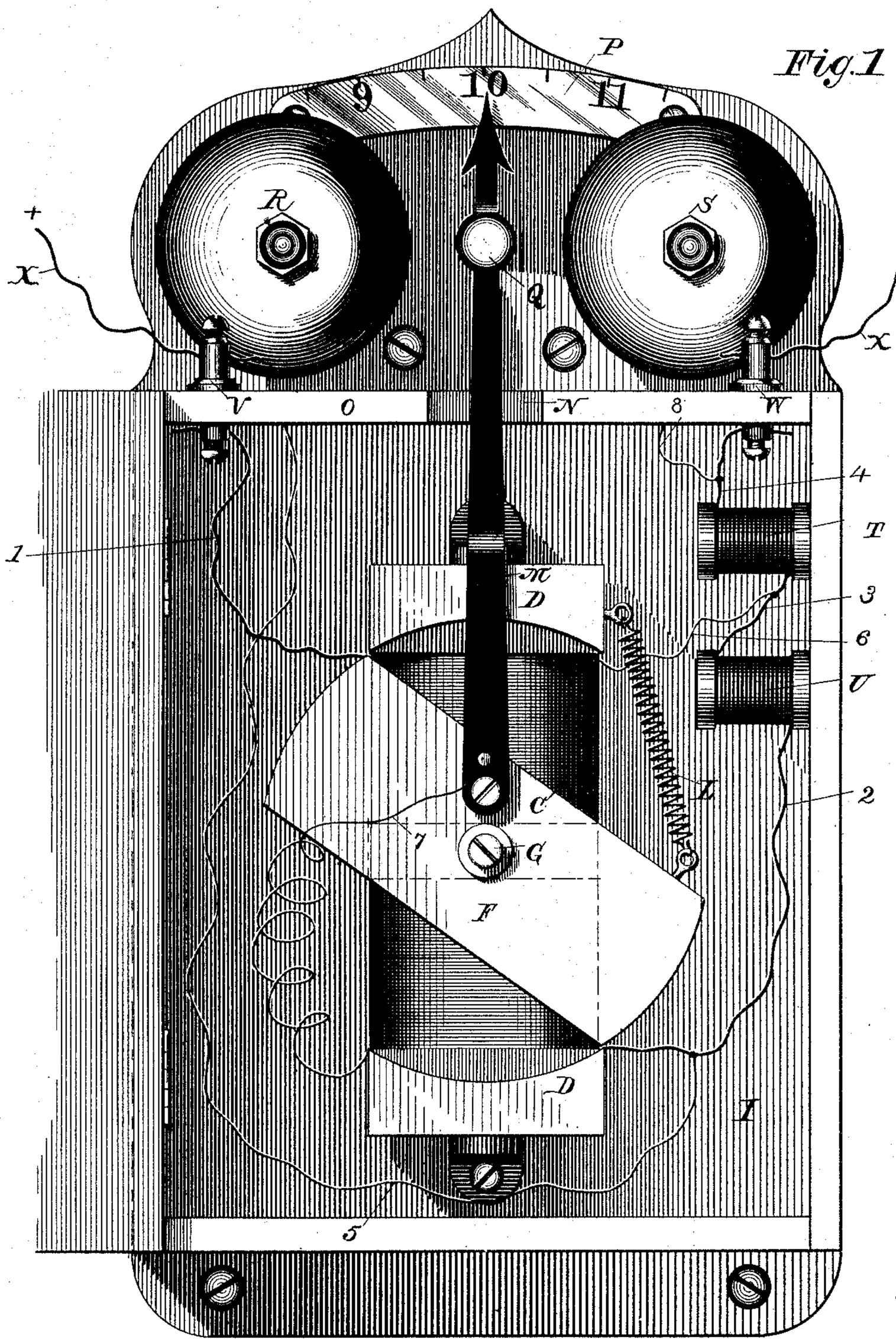
(No Model.) 2 Sheets—Sheet 1.

R. H. MATHER.

ELECTRIC CURRENT INDICATOR.

No. 351,388. Patented Oct. 26, 1886.

Fig. 1



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2

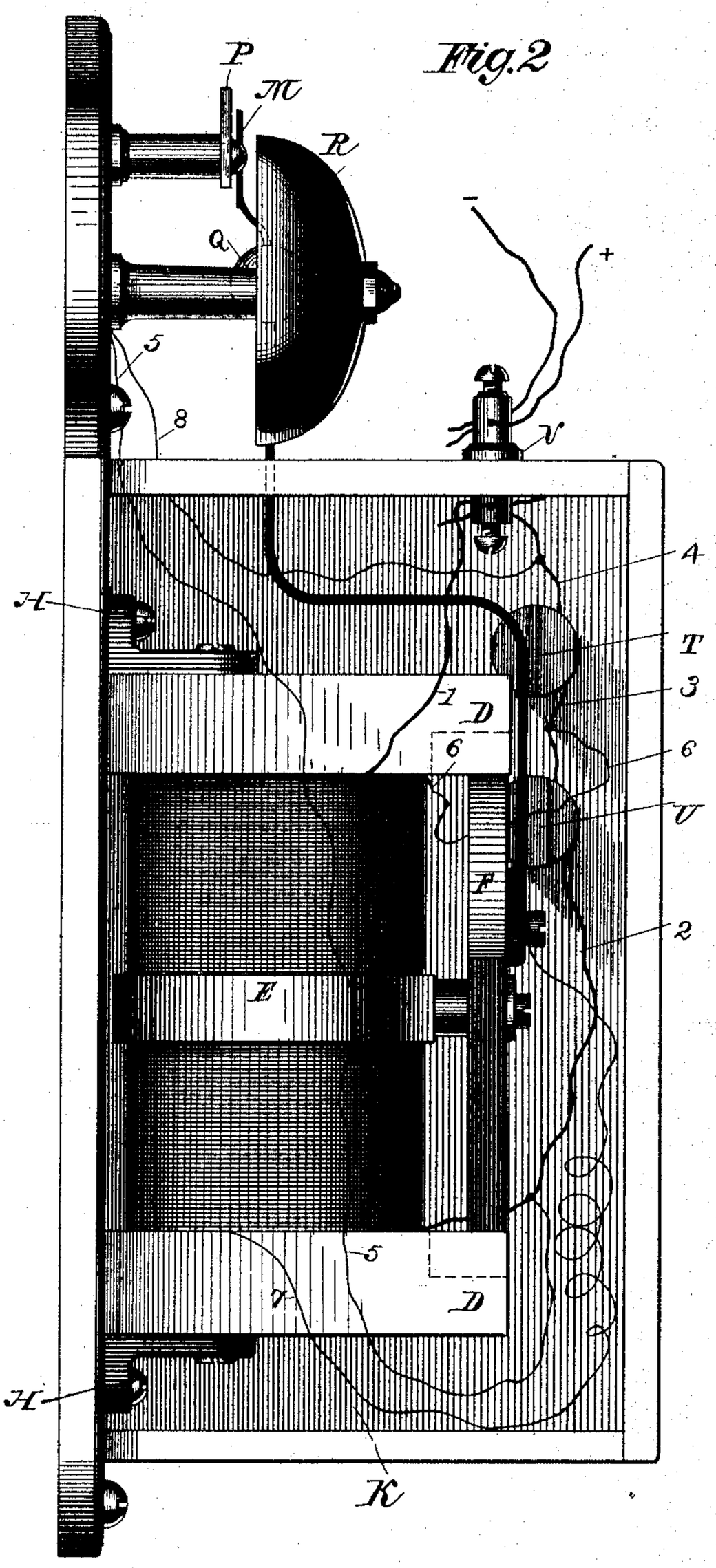
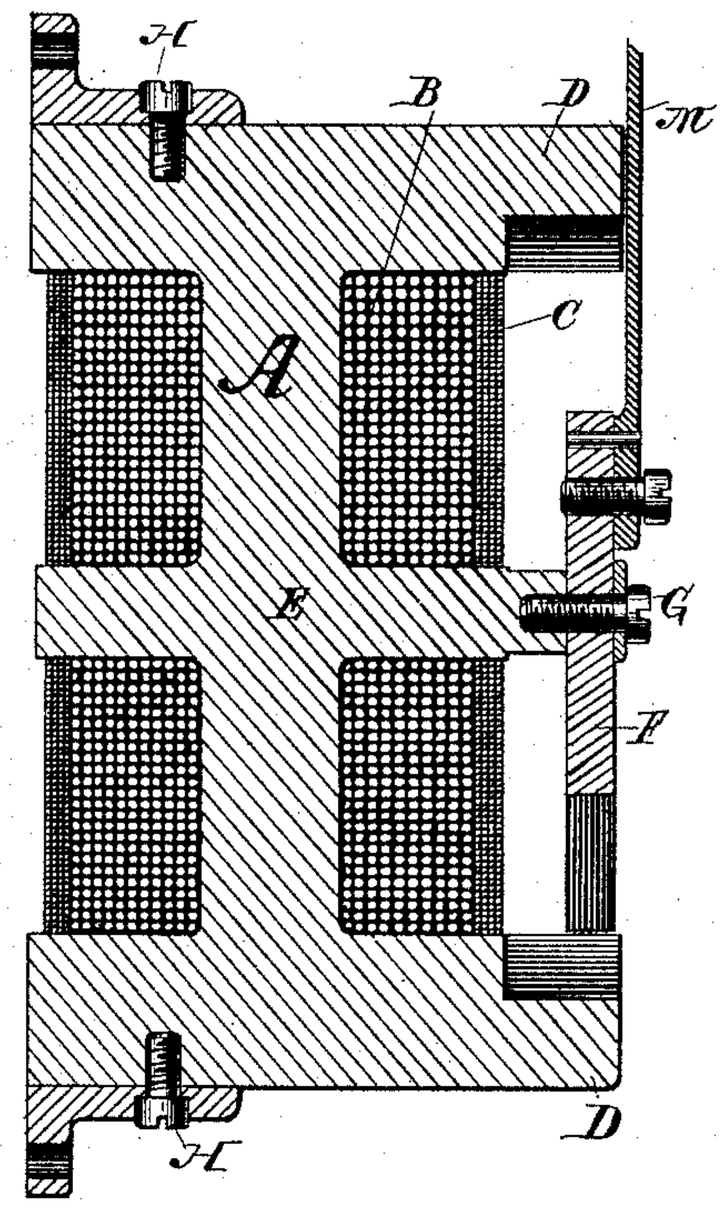


Fig. 3



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UNITED STATES PATENT OFFICE.

RICHARD H. MATHER, OF WINDSOR, CONNECTICUT.

ELECTRIC-CURRENT INDICATOR.

SPECIFICATION forming part of Letters Patent No. 351,388, dated October 26, 1886.

Application filed March 15, 1886. Serial No. 195,197. (No model.)

To all whom it may concern:

Be it known that I, RICHARD H. MATHER, a citizen of the United States, residing at Windsor, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Electric Indicators, of which the following is a specification, reference being had to the accompanying drawings.

My invention relates to visual and audible signals indicating changes in current or electro-motive force in electric circuits.

The object of my invention is to provide a better indicator of such changes than has heretofore been used or known. To accomplish this object I make use of a compound electro-magnet whose armature carries a hammer and pointer, in combination with other electrical and mechanical devices which are illustrated in the accompanying drawings.

In the drawings, Figure 1 is a front view of my improved indicator and a containing-box, the latter being thrown open. Fig. 2 is a side view of the same, the near side of the box being removed. Fig. 3 is a longitudinal section of the electro-magnet which is shown in Figs. 1 and 2.

This magnet comprises a spool or bobbin of soft iron, A, upon which are wound in the usual manner two separate helices, B and C, of insulated copper wire. The ends of the spool A are enlarged and extended in pole-pieces D D, which are concave toward each other on the front side of the magnet. Spool A is further provided with a central annular projection or ring, E, upon which the armature F is mounted by a central pivot or screw, G. Armature F is a plate, which is perforated in the middle for screw G, and is rounded at the ends upon the same curve as the concave of surfaces which are presented thereto by pole-pieces D D.

The helices B and C are respectively formed of coarse and fine wire, and are wound to that degree of electro-magnetic efficiency which is hereinafter stated. This magnet is secured by suitable screws, H, to the back I of the containing-box K. Said magnet is provided with a spring, L, which tends to turn armature F upon pivot G away from pole-pieces D D with a degree of force which is hereinafter specified.

M is a brass pointer, which is rigidly mounted upon armature F, and passes movably through a slot, N, in the top O of box K. The exposed end of pointer M is free to traverse the scale or graduated plate P whenever motion is imparted to armature F. Plate P, which is attached to the upward-projecting back I of box K, is graduated in the manner hereinafter described.

Q is a brass ball or hammer, being an enlargement of pointer M at a convenient distance from the free end of the latter. On opposite sides of pointer M, and within reach of hammer Q, are gongs R and S, which yield noticeably dissimilar tones when struck. This dissimilarity may conveniently be produced by a difference in the pitch of the musical tones emitted, S being pitched high and R being pitched low.

T and U are resistance-coils.

V and W are binding-posts, being the terminals of the indicator.

X X is the electric circuit in which the indicator is inserted. Helix B and resistance-coils T and U are electrically connected in series between said terminals by the coarse wires 1, 2, 3, and 4. Gong R is connected with wire 2 between helix B and coil U by wire 5, while gong S is connected with wire 4 or post W by wire 8. Helix C is connected with pointer M by wire 7, and with wire 3 between coils T and U by wire 6. The normal current of the circuit X X, in which the indicator is placed, is indicated by the central figures upon scale-plate P. Thus the normal current indicated in Fig. 1 is ten ampères.

The electro-magnetic efficiency of helix B and the traction of spring L are such relatively to each other that whenever the normal current traverses helix B the pointer M is held in equilibrium in the position shown in Fig. 1, midway between gongs R and S. The figures 9 and 11 upon scale-plate P indicate those deflections of pointer M which correspond, respectively, with a decrease and increase of current by a single ampère above or below the normal current just mentioned.

The gongs R and S are placed upon opposite sides of the normal position of hammer Q at such equal distances therefrom that said hammer will touch one or the other of said gongs

whenever the pointer M has reached a predetermined amplitude of deflection. Thus in Fig. 1 the hammer Q encounters gong R whenever pointer M is deflected half-way from 10 toward 9 of the scale-plate P, and encounters gong S whenever pointer M is deflected half-way from 10 toward 11 of said plate. Yet the gongs R and S may, if desired, be nearer or farther apart, so that hammer Q can encounter said gongs only when said pointer has reached some other desired or predetermined deflection from its normal position; or said gongs may, if desired, be placed at unequal distances from the normal position of said pointer. The electro-magnetic efficiency of helices B and C is such that when said helices are energized in one and the same direction by an aggregate current of nine and one-half ampères the magnetic attraction exerted upon armature F distinctly exceeds the opposing power of spring L, and when said helices are energized in opposite directions by an aggregate current of ten and one-half ampères the magnetic attraction exerted upon armature F is less than the opposing power of said spring. The resistance of coils T and U is such that in the normal operation of the indicator, as hereinafter described, the current supplied will be distributed to helices B and C in that manner which is involved in the foregoing statement of the relative efficiency of said helices.

The remaining features of construction of this instrument will sufficiently appear from said drawings and from the mode of operation, as hereinafter described.

Such being the construction of my improved indicator, the mode of its operation is as follows: When no current passes through the indicator, the hammer Q is held in contact with gong R by the force of spring L. When a normal current—ten ampères in the present instance—is present in circuit X X, that current passes from binding-post V successively through wire 1, helix B, wire 2, resistance-coil U, wire 3, resistance-coil T, and wire 4 to binding-post W, and the pointer M is held in the position shown in Fig. 1. If the current rises above or falls below ten ampères, the change is indicated to the eye of the observer by a corresponding deflection of pointer M to the right or left before the index-plate P. Whenever the current falls to nine and one-half ampères, or lower, the hammer Q is brought to contact with gong R by the preponderating force of spring L. In that case an electric circuit is closed at the point of contact, so that the current is divided at a point between helix B and resistance-coil U, and passes from terminal to terminal of the indicator in the following manner: From terminal V said current passes undivided through wire 1, helix B, and wire 2 as far as the junction of wires 2 and 5. There the current divides, and while the principal part thereof goes on by the way of wire 2 and passes successively through resistance-coil U, wire 3, resistance-coil T, and wire 4 to terminal W, the residue of the same passes from the junction of wires 2 and 5 successively through wire 5, gong R, hammer Q, pointer M, wire 7, helix C, wire 6, resistance-coil T, and wire 4 to terminal W. The helices B and C are thus energized in one and the same direction, and their combined electro-magnetic effect is such as to cause the hammer Q to be withdrawn from the gong R, notwithstanding the opposing force of spring L; but when the contact between hammer Q and gong R is broken in the manner just stated, hammer Q, being again actuated only by spring L and by the magnetic attraction due to the electro-magnetic efficiency of helix B, is forthwith brought back with a blow against gong R, and by this action, indefinitely repeated, gong R is rung until the current rises above nine and one-half ampères, or falls so low that the entire strength of said magnet is insufficient to break the contact between hammer Q and gong R against the opposing force of spring L. On the other hand, whenever the current rises to ten and one-half ampères, or more, the hammer Q is brought to contact with gong S by the preponderating force of said magnet. In that case an electric circuit is closed at the point of contact between Q and S, so that the current is divided at a point between said resistance-coils, and passes from terminal to terminal of the indicator in the following manner: From terminal V said current passes undivided through wire 1, helix B, wire 2, resistance-coil U, and wire 3 as far as the junction of wires 3 and 6. There the current divides, and while the principal part thereof proceeds by wire 3 and passes through resistance-coil T and wire 4 to terminal W, the residue of the same passes from the junction of wires 3 and 6 successively through wire 6, helix C, wire 7, pointer M, hammer Q, gong S, and wire 8 to terminal V. The helices B and C are thus energized in opposite directions, and their differential electro-magnetic effect is such as to cause hammer Q to be withdrawn from gong S by the preponderating energy of spring L. When the contact between hammer Q and gong S is broken, as described, hammer Q, being again actuated only by spring L and by the maguetic attraction due to the electro-magnetic efficiency of helix B, is forthwith brought back with a blow against gong S, and by this action, indefinitely repeated, gong S is rung until the current falls below ten and one-half ampères, or rises so high that the combined force of spring L and of the attraction due to helix C are insufficient to break the contact between hammer Q and gong S against the opposing force of the attraction which is due to the electro-magnetic efficiency of helix B.

The foregoing statement of the construction and mode of operation of my improved indicator has particular reference to my invention when constructed and used as an ammeter. When constructed and used as a voltmeter, my

indicator has the same construction and operation, except in the following particulars: The aggregate resistance to which the instrument is wound is in that case made to correspond with the electro-motive force which is to be measured. The scale upon plate P is then graduated in a manner indicating those changes in the position of pointer M which correspond with changes of electro-motive force, and the instrument is made a shunt to the circuit whose electro-motive force is to be indicated. In that case the circuit X X, instead of being the main circuit above specified, is a shunt-circuit derived therefrom.

I claim as my invention and desire to secure by Letters Patent—

1. An electro-magnet wound with two independent helices, an armature pivoted between pole-pieces of said electro-magnet, a spring acting upon said armature, and a hammer which is mounted upon said armature, in combination with two gongs which are mounted upon opposite sides of said hammer, and with two resistance-coils which are at all times electrically connected in series with one of said helices, while the other of said helices is connected in parallel with one or the other, or neither, of said resistance-coils, according as said hammer is for the time being in contact with one or the other, or neither, of said gongs, substantially as and for the purpose specified.

2. A compound electro-magnet, a pivoted armature thereof provided with a spring and armed with a pointer, and an index-plate near said pointer, in combination with two gongs which are mounted within reach of said pointer, and with two resistance-coils which are connected in series with one of the helices of said electro-magnet, while the other of said helices is connected in parallel with one or other, or neither, of said resistance-coils, according as said pointer is for the time being in circuit with one or the other, or neither, of said gongs, substantially as and for the purpose specified.

3. An electro-magnet having two independent helices, an armature pivoted within the magnetic field of said electro-magnet, a spring acting upon said armature, and a hammer actuated by said armature, in combination with alarm mechanism and with two resistance-coils which are connected in serieswith one of said helices, while the other of said helices is connected in parallel with one or the other of said resistance-coils whenever said hammer is carried to a predetermined limit in either direction, substantially as and for the purpose specified.

4. An electric indicator consisting of one or more gongs, a hammer for striking the same, and a compound electro-magnet having a pivoted armature actuating said hammer, in combination with two resistances which are connected in series with one of the helices of said electro-magnet, while the other of said helices is connected in parallel with one or the other of said resistances whenever said armature is moved to a predetermined limit in either direction, substantially as and for the purpose specified.

5. The gongs R and S, the resistance-coils T and U, and the hammer Q of pointer M, provided with spring L, in combination with armature F of a compound electro-magnet, and with electrical connections 1, 2, 3, 4, 5, 6, 7, and 8, substantially as and for the purpose specified.

6. A compound electro-magnet, an armature thereof, and a spring acting upon said armature, in combination with two resistances provided with suitable contacts and connections, whereby both of said resistances are at all times electrically connected in series with one of the helices of said electro-magnet, while the other of said helices is connected with one or the other, or neither, of said resistances, according as said armature is moved to a predetermined limit in one direction or in the other direction, or is not moved to that limit, substantially as and for the purpose specified.

In witness whereof I have hereunto set my name in the presence of two witnesses.

RICHARD H. MATHER.

Witnesses:
WILLARD EDDY,
CHARLES E. BYRNE.